Effect of Mindfulness Versus Self-talk on Dart Throwing

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A report submitted as a practical requirement for the degree Bachelor of Psychological Science with Honours at the University of Tasmania, 2017

Statements of Sources

I declare that this report is my own original work and that contributions of others have been duly acknowledged.

Signed: Date: 19/10/2017

Acknowledgement

Thank you to my supervisor, Mr. Peter Tranent for giving me the freedom to create my own research project. I have experienced the steepest learning curve, and I thank you for supporting me throughout this terrifying process.

I would also like to thank Dr Cynthia Honan her ongoing professional guidance and emotional support – thank you for giving me much needed clarity during this time.

Thank you to each of my participants who gave up their valuable time to participate in this project – especially to my cohort members, each of whom contributed time, ideas and support. I am excited to see where your psychology journeys take you.

Thank you to Dr John Mercer and Dr Dean Cooley for your input on the development of the 10-day interventions. And thank you to Eleanor Wilson, for generously donating your time and glorious voice for the recording of interventions.

To Dr Roslyn Le Gautier, I can't express the gratitude I have for you. Thank you for convincing me that my curiosity would be well suited to psychology, and encouraging me to apply to university. Thank you for your ongoing support and guidance with my work. I'll never be able to repay you, but I promise to pay it forward.

Finally, the deepest thank you goes out to my husband Andy, who has moved countries to support me in pursuing my education. Thank you for spending your days off physically recruiting participants for me and participating in each of my cohort's studies. Thank you for being the kindest, most supportive human I've ever met. I will never be able to shake the feeling that I have an unfair advantage in life, having you by my side.

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Abstract

Understanding how athletes can achieve ideal performance states is a growing facet of sports psychology. However, most research in this area has predominantly focused on control-based strategies such as self-talk (ST) while acceptance based strategies such as mindfulness meditation (MM) are less well explored. Based on this empirical gap in the research, the aim of the present study was to investigate, and compare the effects of these two opposing strategies on dart throwing performance. Specifically, it investigated how a 10-day ST intervention versus a 10-day MM intervention affected dart throwing performance across both cognitive and non-cognitive loaded environments. Fifty-two participants (30 female; aged 18-63 years, M = 31.28, SD = 10.96) engaged in cognitive training (mindfulness, self-talk, Lumosity[control]) for ten consecutive days prior to the testing session. During the testing session, participants were given a practice round opportunity (cognitive load absent), before engaging in the competition round (cognitive load present). The present study identified two key findings: (1) MM intervention appeared to be most beneficial in the early stages of skill acquisition; and (2). Controlling one's mental state may be unnecessary and unrelated to enhanced athletic performance, regardless of cognitive load.

Performance Enhancement

Helping athletes achieve ideal performance states is a growing facet of applied sport psychology. Most commonly, helping athletes perform optimally has been achieved through implementation of cognitive behavioural methods to develop self-regulation (Whelan, Mahoney, & Meyers, 1991). Imagery and relaxation were some of the first strategies to be empirically supported within the motor learning literature. They demonstrated that mental practice aided in acquisition and retention of complex motor skills (Richardson, 1967). Since then, there has been a surge of empirical support for the positive influence of mental training – coined as *Psychological Skills Training* – on performance in the field of applied sport psychology (Blakeslee & Goff, 2007; Thelwell, Weston, & Greenlees, 2010). The development of Psychological Skills Training (PST) is based on the belief that self-control over internal states is an essential element of the ideal performance state. Theories such as Meichenbaum's (1977) integrative approach to cognitive behavioural modification have therefore largely influenced the development of PST. Additionally, it is believed that negative internal states – such as negative thoughts, bodily sensations and emotions – will diminish performance (Gardner & Moore, 2004). Consequently, PST is implemented as a means of control and reduction of negative states to enhance performance (Gardner & Moore, 2004). For example, athletes frequently employ skills such as attentional control, goal setting, imagery, relaxation and self-talk to increase confidence and concentration and lower levels of anxiety and negative thinking to enhance performance (Blakeslee & Goff, 2007; Gardner & Moore, 2004; Thomas, Murphy, & Hardy, 1999). Due to being viewed as the key to cognitive control (Hardy, 2006), *self-talk* is one of the most frequently employed psychological skills and will therefore be used to examine the effects of control based strategies on physical performance.

Self-talk

The term *self-talk* [ST] originated from Zinsser, Bunker and Williams (1993) and was simply defined as "anytime you think about something, you are in a sense talking to yourself" (p. 226). A more elaborate definition was provided by Hackfort and Schwenkmezger (1993), which highlighted specific applications of ST. For example, the researchers emphasized that ST is "a dialogue [through which] an individual interprets feelings and perceptions, regulates and changes evaluations and convictions, and gives him/herself instructions and reinforcement" (p. 355). Building on this definition, Theodorakis, Weinberg, Natsis, Douma and Kazakas (2000), further defined ST to include "what people say to themselves either out loud or as a small voice inside their head" (p. 254). This further illustrates that ST can be said either covertly or overtly, as well as consisting of statements that are addressed specifically to oneself and not to others (Hardy, 2006).

Although the valence dimension of ST – that is, positive versus negative – has received the most attention, research has yet to clarify its importance as findings supporting positive over negative ST have been mixed thus far; with laboratory studies supporting positive ST, as opposed to field based studies which found support for both (Hardy, 2006). Hardy, Gammage, and Hall (2001) suggested focusing on the purpose, rather than content of ST to be of more use, with their qualitative data falling into *instructional* or *motivational* dimensions. Zinsser et al. (1993) argued that motivational ST (i.e., *"you can do it"* or *"hang in there"*) assists performance by boosting energy, confidence, and mood, and is therefore most advantageous for tasks that are based on strength, power and speed. Instructional ST (i.e., *"elbow straight"* or *"stay low"*) however, facilitates performance through attentional focus on technical and strategic aspects of motor skills such as timing and precision, and is therefore more beneficial for tasks requiring accuracy and concentration (Theodorakis et al., 2000). Due to the ease of objectively testing motor skills which require accuracy and

concentration (over skills based on power and speed), and to match the self-talk to the demands of the task, the current study will focus on implementation and effects of instructional ST.

Along with self-regulation, attention has been identified as crucial element of successful performance. Abernethy (1993) argued that it would prove difficult to identify a factor "more important to learning and performing skills than paying attention to the task at hand" (p. 127). As such, the present study will discuss two different strategies (self-talk, mindfulness) for enhancing individuals' self-regulation and attention.

Mechanisms of Self-Talk

Self-regulation. Prior research suggests that the language used to refer to the self can promote self-distancing; a process that allows individuals to think about irrational thoughts more objectively (Beck, 1970). Therefore, a crucial element of ST is how it is implemented. Kross et al. (2014) demonstrated that the use of non-first-person pronouns (or the use of one's own name) to refer to the self promoted self-regulation. As non-first-person pronouns (i.e., *"you"* or *"James"*) are most often applied when thinking about, referencing or talking to other people, it is believed that implementation of these components of speech to refer to the self results in more objective thought processes because it allows a person to think about themselves as though they were someone else. Findings revealed that using non-first-person language to refer to oneself during introspection resulted in quicker recovery from social stressors as well as allowing individuals to appraise social-anxiety-provoking situations in less threatening terms, compared to the first-person language group (Kross et al., 2014).

Attention. Landin (1994) suggested that the effectiveness of instructional ST is due its effects on attention. Instructional ST is made up of verbal cues (concise phrases such as "*follow through"* or *"low, rhythm"*) which are used to enhance attentional focus and redirect attention to task relevant cues. Investigating the effects of instructional ST on dribbling,

passing and shooting of a basketball, Perkos, Theodorakis, and Chroni (2002) discovered that participants who utilized verbal cues such as “hand, centre” and “fingers, target” showed significant improvement in skills they were working on. Additionally, implementing instructional ST had a moderate effect (d = .54) on reduction of frequency of interfering thoughts during task execution (Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004). Lastly, Landin (1994) proposed that through implementation of verbal cues, ST improves information processing as it facilitates both recognition and recall of relevant information. This is achieved through the process of ‘chunking’ multiple aspects of a complex movement sequence, which reduces the amount of attention required for performing movement ‘chunks’ (Hardy, 2006).

However, Gardner and Moore (2007) question Landin's (1994) contention that instructional ST enhances attention, particularly the notion that ST enhances task-focused attention (i.e. external stimuli, options and contingencies). Instead, Gardner and Moore point out that attempts to control mental activity increases *self*-focused attention (i.e. internal state, such as thoughts and emotions) which due to its controlled, effortful verbal-linguistic cognitive process, often interrupts effective performance. Gould, Jackson, and Eklund (1992) found that task-irrelevant (i.e. self-focused) attention was highly associated with poor athletic performance among members of the 1988 U.S. Olympic Wrestling Team.

Ironic Processes of Mental Control

An increasing body of literature questions the contention that control of internal states enhances performance (Gardner & Moore, 2004; Hasker, 2010; Wegner, Ansfield, & Pilloff, 1998). It has been argued that control based strategies fail to consider the paradoxical effects of mental control under the reduced cognitive capacity commonly experienced in competition (Gardner & Moore, 2004; Hasker, 2010; Wegner, 1994; Daniel M. Wegner et al., 1998).

According to Wegner (1994), attempts to control one's mental state under reduced cognitive capacity often results in the opposite of the desired state. Wegner proposed that a want for a mental state (such as relaxation) creates an *operating process* which consciously searches for items consistent with the desired state, filling the mind with thoughts and sensations relevant to the desired state to increase the likelihood of achieving it. Simultaneously, the non-conscious *monitoring process* searches for thoughts and sensations inconsistent with successful control; for indication that mental control is failing. If such inconsistencies arise, this signals the operating process that more control is needed. Due to its unconscious nature, the monitoring process requires little cognitive effort and continues until the attempted mental control is consciously ended (Wegner, 1994). If mental capacity is compromised (distraction, time pressure, intoxication etc.), the effortful operating process becomes limited, allowing the monitoring process to dominate. The monitoring process invites the unwanted thoughts it has been scanning for into consciousness, overriding any intended control (Clark, Ball, & Pape, 1991; Wegner, 1994). Therefore, when conscious cognitive capacity is limited, efforts to control one's mental or emotional state increases unwanted cognitions and emotions (Clark et al., 1991). Such findings suggest that attempting to control one's mental state would only prove to be advantageous when one has available cognitive resources to do so. Conversely, attempting to control one's mental state in a cognitively demanding situation such as competition may degrade performance. Importantly, applying this theory to physical action yielded similar results. Wegner et al. (1998) discovered that when participants were cognitively loaded, attempts to not overshoot a golf putt induced a significant overshoot, and attempts to not swing a pendulum in a specific direction provoked a swing in the undesired direction.

Such findings question the efficacy of control based strategies for achieving an optimal performance state, and importantly, question why this has been the most common

intervention to date (Röthlin, Horvath, Birrer, & Holtforth, 2016). A review of the self-talk literature highlighted a possible explanation for this. Out of the twelve studies reviewed (see Appendix H), none investigated the effects of self-talk in a stressful or cognitively demanding context characteristic of competition. Specifically, none of the participants experienced cognitive load previously shown to elicit ironic effects. Furthermore, in order to determine the degree of empirical support for traditional control based strategies, a qualitative review (based on previously established criteria for empirical support as recommended by Chambless & Hollon, 1998) of literature employing such strategies yielded non-significant results (Moore, 2003). Of the four studies that met the criteria for self-talk, Moore (2003) found none demonstrated significant performance enhancing effects.

Recent empirical research describing self-regulatory processes across varying human performance domains suggest that consistent functional human performance requires "meta-cognitive" attention to external cues, options and contingencies (Gardner & Moore, 2004). Gardner and Moore (2006) describe "meta-cognition" as an individual's awareness, evaluation, and response to their own cognitions, and is therefore considered synonymous with a contrasting strategy – mindfulness. Additionally, Gardner and Moore suggest that optimal self-regulation is accomplished through minimal self-judgment, minimal vigilance of external or internal threat, and minimal worry about potential consequences of performance. Findings have demonstrated that such as state is most commonly achieved by engaging in mindfulness meditation [MM] (Brown & Ryan, 2003).

Mindfulness Meditation

Mindfulness, which originated in Eastern meditation practices, is a process of bringing a specific nature of attention to present-centred experience (Baer, 2003; Bishop et al., 2004). According to Kabat-Zinn (2003), mindfulness is most usefully defined as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (p. 145). In line with that definition, Bishop et al. (2004) proposed that mindfulness operates with two components; (1) self-regulation of attention in the present moment, and (2) an openness, acceptance and curiosity of the present-moment experiences. Shapiro et al. (2010) broadened the definition to include *intention* (why one is practising), which is considered to be a crucial element to understanding the process. According to Shapiro et al., mindfulness is a cyclical process of three interwoven axioms – that is, intention, attention and attitude – occurring simultaneously. Therefore, rather than attempting to control or change the form or frequency of one's cognitions and emotions (as is the basis of traditional PST skills), the focus of mindfulness is to *modify* one's relationship with them (Gardner & Moore, 2012). Such qualities of awareness and attention can be cultivated through the practice of meditation, so that meditation is simply the "scaffolding" used to develop mindfulness (Baer, 2003; Shapiro et al., 2010).

Mechanisms of Mindfulness

Self-regulation. It was suggested that intentionally attending in a non-judgmental and open way, leads to a significant shift in perception, termed *reperceiving* (Shapiro et al., 2010). It is hypothesised that reperceiving is a meta-mechanism of action, directly affecting additional mechanisms such as self-regulation and cognitive, emotional and behavioural flexibility. Similarly to the self-distancing mechanism of self-talk, reperceiving allows the meditator to disidentify from the contents of their consciousness, resulting in clarity and

objectivity of their moment-to-moment experience (Kross et al., 2014; Shapiro et al., 2010). The process of reperceiving allows the meditator to experience a negative emotion (such as anxiety) as simply an arising emotional state which will pass in time. Instead of needing to control or change an unpleasant internal state, reperceiving heightens one's level of tolerance for it, freeing the meditator from what would normally be an automatic behavioural response to such a state (Shapiro et al., 2010). It has also been suggested that reperceiving facilitates cognitive and emotional flexibility as it enables observation of one's mental commentary about encountered experiences. Such observations allow the meditator to respond accordingly to the present situation instead of with reactionary thoughts and emotions triggered by prior conditioning and experience (Shapiro et al., 2010). Laboratory research by Brown and Ryan (2003) supports MM being associated with heightened self-knowledge, as participants scoring higher in the Mindful Attention Awareness Scale (MAAS) demonstrated more consistency in reporting their implicit and explicit affective experience.

Attention. A key dimension of MM is mental training of attention (Slagter et al., 2007). Such mental training therefore enhances one's capacity to attend for long periods of time to one object. fMRI research investigating the attentional underpinnings of MM demonstrated a stronger activation of overlapping networks of brain regions associated with attention for participants engaged in meditative practise (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007). Furthermore, Shapiro et al. (2010) propose that MM strengthens one's ability to shift the focus of attention between mental sets or objects at will. This was examined by Slagter et al. (2007) using scalp-recorded brain potentials and performance in an attentional-blink task. Slagter et al. discovered that MM training resulted in a more efficient allocation of attentional resources, with experienced meditators allocating less cognitive resources to the first target (T1) presented in the attentional-blink task compared to controls. Allocating less cognitive resources to the T1 allowed for better

detection of the second target (T2), resulting in a smaller attentional blink. Such findings demonstrate that MM training may allow for increased control over the distribution of limited cognitive resources (Slagter et al., 2007). This is potentially useful for athletes in competition where efficiency of attention in situations of situational conflict is crucial for success.

Furthermore, Gardner and Moore (2004) argue that if mindful, non-judging present-moment attention and acceptance of internal experiences is achieved, that such a combination of characteristics closely resemble a common sport psychology concept – *flow.* Csikszentmihalyi (1990) describes "flow" as qualities such as "the merging of action with awareness" (p. 53), "concentration on the task at hand" (p. 58), and "the loss of self-consciousness" (p. 62). As the state of "flow" has been associated with improved athletic performance, it is regarded as an important attainment for athletes (Csikszentmihalyi, 1990). In examining the relationship between the state of "flow" and trait mindfulness in elite athletes, Cathcart, McGregor and Groundwater (2014) found correlations between trait mindfulness and flow (r = .34), suggesting a relationship between the two is present.

Lastly, unlike control based strategies, the application of mindfulness based strategies in highly demanding situations does not produce ironic effects. In contrast, Röthlin et al. (2016) suggested that mindfulness plays a moderating role in the relationship between competition anxiety and performance delivery in highly demanding situations, based on findings which demonstrated that trait mindfulness promoted more adaptive responses to stressful situations (Arch & Craske, 2010).

The present study

Rationale

Both ST and MM have been shown to enhance performance, however, they do so by implementing opposing strategies; ST attempts to control our experience, whereas MM alters how we relate to the experience by accepting it as is. Whilst literature comparing control based strategies (such as traditional PST) have been abundant, research comparing control based vs. acceptance based strategies is sparse. The only current published literature comparing the effectiveness of control based vs. acceptance based strategies so far has been conducted by Hasker (2010), who failed to find significant results. However, Hasker's use of self-report data and lack of control condition are noteworthy limitations.

To date, studies on PST have produced inconstant findings (see qualitative review by Moore, 2003). Furthermore, the ST research has failed to address the efficacy of control based strategies under cognitively loaded circumstances, which, according to Wegner (1994), elicit ironic effects. It has also been argued that one of the major shortcomings of ST research is that the prescribed ST is often scripted by researchers themselves, and therefore potentially unfamiliar to participants (Harvey, Van Raalte, & Brewer, 2002). Findings have indicated that discomfort with assigned ST was one of the major barriers of implementing a positive ST strategy for improving dart throwing performance (Masciana, Van Raalte, Brewer, Branton, & Coughlin, 2001). In the context of mindfulness research, the targeted participants commonly consist of pre-existing groups, which undermines external validity. When random allocation was present with a control condition, this often resulted in reduction of mindfulness training experience. For example, Masciana et al.'s (2001) mindfulness training consisted of a written paragraph describing the method for participants to read. Meanwhile, Lueke and Gibson (2014) administered a 10- min mindfulness recording to their participants. Both strategies threatened the internal validity of the research.

Aim

The first aim of the present study is to investigate the effects of a 10-day Mindfulness intervention compared to a 10-day Self-Talk intervention on dart throwing performance. According to a number of sport psychologists, dart throwing is considered to be an ideal task for exploring the effects of psychological interventions, as minute variations in performance can be measured via examination of the dart board (Kolovelonis, Goudas, & Dermitzaki, 2012; Masciana et al., 2001). The second aim of the current study is to overcome the lack of cognitive loading found in prior ST research by limiting mental capacity. As both time pressure and performance anxiety have been identified as factors that reduce mental capacity (Wegner, 1994), restricted time limit measured by a loud timer will be present. Additionally, participants will be treated as competitors with strict instruction for both practise and competition shots with reminders of cash prizes for best throwers. The third aim of the present study is to address concerns raised by Harvey, Van Raalte, and Brewer (2002) regarding the use of a prescribed ST script (which participants are unfamiliar with), participants in the present study will be implementing self-assigned ST.

By investigating dart throwing performance, the present study addresses the limitations associated with self-report data as dart throwing lends itself to empirical observation. Additionally, the present study will address Hasker's (2010) limitation of lack of control group by implementing a control condition. Based on many findings demonstrating its lack of cognitive enhancement (such as Shute, Ventura, & Ke, 2015), Lumosity brain training will be used as a control condition (CTR). As random allocation will be used instead of pre-existing groups, the present study will address prior shortcomings of mindfulness research by implementing a more rigorous MM training lasting 10-days in duration. According to Gardner and Moore (2012) such duration should be adequate to produce significant difference in behavioural responses.

Hypotheses

***H_1*: Practice shots (cognitive load absent).** Based on extensive empirical support for both PST and mindfulness training, it is hypothesised that the ST and MM groups will outperform the CTR group during the practice shots. Therefore, our hypothesised pattern of results for the practice round is as follows: MM = ST > CTR.

***H_2*: Competition shots (cognitive load present).** In accordance with the Ironic Process Theory, it is hypothesised that the cognitive load of time pressure will elicit ironic effects for the ST group, as participants in this group will be actively attempting to control their cognitions. Therefore, it is hypothesised that both MM and CTR groups will score higher during the competition shots as they are not (consciously) attempting to control their cognitions. Additionally, considering the positive effects of mindfulness on both self-regulation and attention, it is further hypothesised that the MM group will score higher than the CTR group in the competition shots. Therefore, our hypothesised pattern of results for the competition round is as follows: MM > CTR > ST.

Method

Design

This study utilised general linear model planned contrasts for testing both hypotheses. H_1 was tested with two planned contrasts. The first contrast compared the two intervention groups to the control (ST + MM vs. CTR), and the second contrast compared the two intervention groups (ST vs. MM). H_2 was tested using a linear contrast to test the predicted linear pattern of results (MM > CTR > ST). In both cases, the IV was cognitive training (MM, CTR, ST) and the DV was the dart throw average (practice and competition rounds).

Participants

The sample consisted of 52 participants (30 females, 22 males) aged between 18 and 65 years (M = 31.28, SD = 10.96), who were randomly assigned to either control (CTR), self-talk (ST) or mindfulness meditation (MM) groups. A power analysis (a-priori) was conducted using G*Power 3.1.9.2 based on previous ST research which examined effects of ST on learning a new motor skill (Kolovelonis, Goudas, & Dermitzaki, 2011). G*power analysis revealed that with an estimated medium effect (Cohen's f = .40, with power of 0.95 and alpha at 0.05), a sample of 52 participants would allow for reliable detection of the hypothesised patterns of results. A chi-square test of independence determined there to be no significant difference in gender distribution, $\chi^2(2, N = 52) = 1.39$, $p = .499$, and a one-way ANOVA determined that age did not differ significantly between groups, $F(2, 49) = .26$, $p = .769$.

Materials and Procedure

Recruitment. Participants were recruited via Division of Psychology (UTAS Psychology Research Participation System), Health and Sports Science UTAS webpages, as well as the researcher's social groups (see Appendix D).

Part one: Online Training. Participants were asked to create a username for training host site ("Thinkific", 2017), to access daily cognitive training. Mindfulness training was created using Cayoun's (2008) instruction manual based on mindfulness meditation teachings from Satya Narayan Goenka (see Appendix E), before being vetted by a relevant expert in the field (Dr John Mercer). Daily audio sessions on MM practise were recorded by a voice-over artist ("Eleanor Wilson", 2017) with incrementally increased timed silent pauses. ST training was created using multiple sources (Cox, 2012; Hardy, Jones, & Gould, 1996; Weinberg & Gould, 2015) and vetted by a relevant expert in the field, Dr Dean Cooley (for ST script, see Appendix F). Instructions were recorded by the same voice-over artist ("Eleanor Wilson", 2017) to minimise any confounding variables. Participants were instructed to develop their own ST over the 10-day period. Control training was made up of multiple daily brain training activities designed by Lumosity, aimed to enhance cognitive processes such as; divided attention, information processing, task switching, spatial orientation, response inhibition and working memory ("Lumosity", 2017). Daily progress was monitored via a host site ("Thinkific", 2017), with a minimal 70% completion rate requirement for progression onto Part 2 of the study (overall completion rate was $M = 93.52$, $SD = 9.73$).

Part Two: Testing session. Participants were invited to attend an on-campus testing (referred to as "*The Competition*") within three days of completion of online training. Upon arrival, each participant was given an Information sheet after which they gave consent in writing prior to testing (see Appendices B and C).

Self-report measures. We first administered several self-report measures, which included:

Trait mindfulness. Participants took the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), which consists of 39 items measuring: observing (8 items), describing (8 items) acting with awareness (8 items), non-judging (8 items) and non-reacting (7 items). Participants were asked to rate the extent to which they believed statements (e.g. *"I pay attention to sensations, such as the wind on my hair or sun on my face"*) were generally true of them on a scale from 1 (*never or rarely true*) to 5 (*very often or always true*). Facet scores were computed by summing the scores on the individual items with higher scores indicating more mindfulness. Strong internal consistency reliabilities (α = .75 - .91) have been demonstrated for all factors as well as the total scale.

Hypercompetitive attitude. Participants took the Hypercompetitive Attitude Scale (HCA; Ryckman, Hammer, Kaczor, & Gold, 1990), which consisted of 26 items (e.g. *"I find myself turning a friendly game or activity into a serious contest or conflict"*) which participants rated from 1 (*never true of me*) to 5 (*always true of me*). The HCA has shown to have strong internal consistency reliability, α = .91 (Ryckman et al., 1990).

Previous dart throwing experience. Participants were asked to inform us of any previous dart throwing experience by circling one of the options provided; *Never* (0 times), *Rarely* (1-5 times), *Occasionally (*5-10 times), *Often* (10-20 times) and *Expert* (20+ times).

Manipulation Checks. We administered manipulation checks to the ST and MM groups post competition. These included:

State Mindfulness. MM participants took the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013), a 21-item questionnaire assessing one's perceived level of awareness and attention (e.g. *"I tried to pay attention to pleasant and unpleasant sensations"*) to their present mental (15 items) and physical (6 items) experience. Participants were asked to rate

the extent to which the above statements were true of their experience over the past 10-minutes, on a scale ranging from 1 (*not at all)* to 5 (*very well*). Strong internal consistency reliabilities (α = .90 - .95) have been demonstrated for both the mental and physical factors as well as the total scale (Tanay & Bernstein, 2013).

A ST manipulation check based on research by Kolovelonis, Goudas and Dermitzaki (2011) was administered to the ST participants post performance. Participants were asked if they implemented their self-assigned ST successfully (*Y/N*) along with questions regarding qualitative information (see appendix J). Participants were also asked about their opinions on the efficacy of ST (e.g. *"I found the implementation of my self-talk to be useful*"), as well as the extent to which they found the implementation of their ST to be easy (e.g. *"I found it easy to implement my self-talk"*) which they answered on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*).

Dart throwing materials. A straight target board made up of ten concentric circles with a diameter of 18 in. (45.72 cm) was used for ease of instruction as well as increase of scoring sensitivity. The board was attached to a wall so that the centre of it was at the international regulation height of 5 ft. 8 in. (172.72 cm) from the floor (Masciana et al., 2001). A strip of tape 3 ft. (91.44 cm) long was placed on the floor 8 ft. (243.84 cm) from the vertical plane containing the front face of the dartboard, to signal regulation throwing distance (Masciana et al., 2001). Nine darts were used for both practice and competition rounds. Each round of throws was photographed from multiple angles to increase scoring accuracy (see Appendix I). The score for each throw was calculated according to how close the dart hit the bullseye, ranging on a scale from 10 (bullseye) to 0 (outside the dartboard). Participants were instructed that only the darts left on the board at the end of all nine throws would be counted. Therefore, the final score was divided by 9 for a dart throw average score.

Data collected was de-identified and scored externally in a double-blind fashion to minimize bias.

Competition instructions. Each participant received scripted instructions on how to hold, aim and throw a dart (see Appendix G). As a reference point, each participant was informed that the best throwers thus far had landed 75% of their darts within the six-ring radius.

Cognitive training. Each group was then instructed to engage in cognitive training. For both the ST and MM groups, this included voiced instruction recorded by voice-over artist ("Eleanor Wilson", 2017), followed by silent pause of approximately 4 minutes to allow participants to engage in either meditative or self-talk practise. For the CTR group, this included engaging in two games of "train of thought" levels 7 and 8 on the Lumosity website ("Lumosity," 2017).

Practice shots. Participants were instructed to take time familiarizing themselves with the set task, and encouraged to implement strategies covered in dart throwing instructions. Participants were instructed to use all, but only nine darts for their practice shots. It was explicitly stated that their practice shots would not be counted for competition.

Competition shots. Participants were informed that they had 36 seconds to throw all nine darts. It was explicitly stated that this timeframe had been calculated to provide enough time to "tap into" one's cognitive training prior each throw. Participants were encouraged to take a moment before beginning, as the timer would only begin after they had taken their first throw.

Results

IBM SPSS Statistic version 24.0 was used to conduct all analysis with alpha levels set at .05 for comparisons of statistical significance. Effect sizes for ANOVA contrasts will be reported using Eta-squared (η^2), following Cohen's (1988) and Miles and Shevlin's (2001) criteria of 0.01 for a small effect, 0.06 as a medium effect, and 0.14 as a large effect size.

Data Cleaning

At the outset of analysis, all data was screened to ensure that appropriate assumptions had been met. As this study utilised planned contrasts, the assumptions of concern were normality and homogeneity of variance (Field, 2014). Inspection of the skewness, kurtosis and Shapiro-Wilk statistics indicated that the assumption of normality was supported in all conducted analyses. Data was adjusted for one outlier who scored two standard deviations and above the mean. Additionally, to minimise the confounding variable of prior dart throwing experience, as well as providing a more accurate insight into learning effects, the following data were removed from the final analysis: (1) participants who revealed they played darts “often” and (2) participants who rated themselves as “expert” dart players (N = 3). Final analysis consisted of data from 49 participants (30 females, 19 males), aged between 18 and 65 years (M = 31.28, SD = 10.96). A chi-square test of independence determined there to be no significant difference in gender distribution after the removal of (N = 3) participants’ data, $\chi^2(2, N = 49) = 2.73$, $p = .256$. Additionally, a one-way ANOVA determined that age did not differ significantly between groups after the removal of (N = 3) participants’ data, $F(2, 46) = .42$, $p = .658$. Levene’s test of homogeneity was non-significant suggesting homogeneity was not violated in any of the conducted analyses.

Manipulation checks

To investigate participants' pre-existing trait mindfulness levels, the FFMQ (Baer et al., 2006) was completed by all participants. A one-way ANOVA revealed there to be no significant differences between MM (M = 130.88, SD = 17.40, 95% CI [121.94, 139.83]), ST (M = 129.69, SD = 16.02, 95% CI [121.15, 138.27]) and CTR (M = 121.50, SD = 19.42, 95% CI [111.15, 131.85]) participants' trait mindfulness, $F(2, 46) = 1.36$, $p = .268$.

To investigate participants' levels of competitive attitude, the HCA (Ryckman et al., 1990) was completed by all participants. A one-way ANOVA revealed there to be no significant differences between MM (M = 58.18, SD = 10.51, 95% CI [53.77, 64.58]), ST (M = 58.75, SD = 12.80, 95% CI [51.93, 65.58]) and CTR (M = 56.06, SD = 10.37, 95% CI [50.54, 61.59]) participants' levels of competitive attitude, $F(2, 46) = .37$, $p = .696$.

To determine participants' previous dart throwing experience, a questionnaire assessing their previous dart throwing experience was completed prior to testing. A one-way ANOVA determined there to be no significant difference between MM (M = 2.47, SD = .62, 95% CI [2.15, 2.79]), ST (M = 2.31, SD = .60, 95% CI [1.99, 2.63]), and CTR (M = 2.25, SD = .77, 95% CI [1.84, 2.66]) participants' prior dart throwing experience, $F(2, 46) = .48$, $p = .623$.

As SMS measures were not obtained from ST and CTR groups, a comparison was made between the SMS scores reported by the present study's MM participants to the mean scores of mindfulness intervention groups in other research. Following a 10-minute mindfulness training, SMS scores for intervention (M = 69.53, SD = 15.21) and control (M = 55.75, SD = 11.87) were reported by Lueke and Gibson (2016). Following four weekly 60-minute mindfulness sessions 7 days apart, SMS scores for intervention (M = 83.80, SD = 22) and control (M = 68.20, SD = 16.50) were reported by Tanay, Lotan and Bernstein (2012). Given that the present study's intervention was more rigorous than Lueke and Gibson's 10-

minute recording, and somewhat less rigorous than Lotan and colleagues' four weekly 60-minute mindfulness training sessions, the present study's SMS score (M = 74.53, SD = 8.20) seems to accurately represent the rigour of its mindfulness training therefore, allowing the researchers to infer that their mindfulness meditation manipulation was successful.

To determine participants' implementation of self-assigned ST, a questionnaire assessing (a) whether participants implemented their ST (b) [if yes] whether it was useful; and (c) [if yes] whether it was easy to implement, was completed by ST participants post competition. Ninety-four percent of the participants (15 out of 16) indicated they implemented their self-talk. Out of the 15 who implemented their self-talk, all 15 found it (on a scale of 1 to 5) both useful (M = 4.06, SD = .44) and easy to implement (M = 4.13, SD = .72), indicating the study's ST manipulation was successful.

H_1: Practice Round (cognitive load absent)

To examine hypothesised pattern of results for the practice round (H_1: MM = ST > CTR), a general linear model planned contrasts analysis was conducted (1 = MM, 2 = CTR, 3 = ST). The first custom hypothesis test (coefficients -1, 2, -1) was non-significant, $F(1, 46)$ = .18, p = .672, η^2 = .004, indicating that MM (M = 4.16, SD = 1.66, 95% CI [3.31, 5.01]) and ST (M = 2.99, SD = 1.97, 95% CI [1.94, 4.04]) groups did not outperform the CTR (M = 3.30, SD = 1.50, 95% CI [2.50, 4.10]) group in their dart throw average score during the practice round. The second custom hypothesis test (coefficients -1, 0, 1) was also non-significant, $F(1,46)$ = 3.11, p = .084, η^2 = .063. However, a moderate effect was identified.

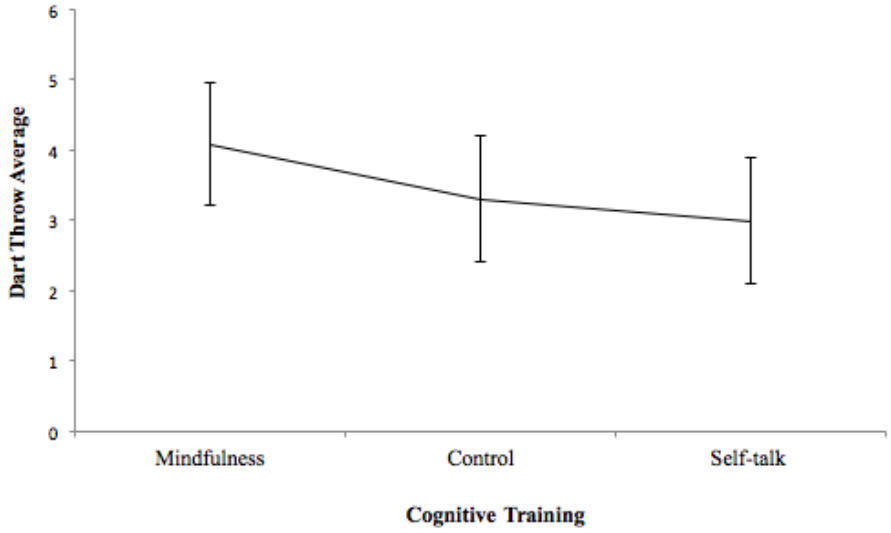

Figure 1. Practice round dart throw average for mindfulness, self-talk and control groups. Error bars show 95% CIs.

H_2: Competition Round (cognitive load present)

To test the hypothesised pattern of results for the competition round (H_2: MM > CTR > ST) a general linear model planned linear contrast (1 = MM, 2 = CTR, 3 = ST, coefficients -1, 0, 1) was conducted. The results were not statistically significant, $F(1, 46) = 3{,}11$, $p = .084$, $\eta^2 = .06$. However, a moderate effect was identified.

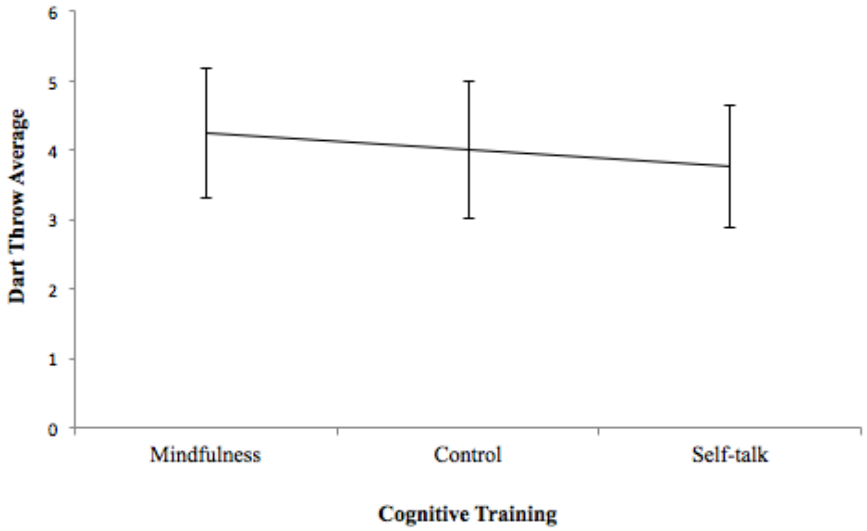

Figure 2. Competition round dart throw average for mindfulness, self-talk and control groups. Error bars show 95% CIs.

To examine possible confounds and competing explanations, a Pearson's correlation analysis was conducted. Variables such as; FFMQ (total), FFMQ-Observe, FFMQ-Describe, FFMQ-Awareness, FFMQ-Non-judging, FFMQ- Non-reactivity, HCA and improvement from practice to competition rounds [DIFF] were examined to determine if any linear relationships were present. The correlational analysis revealed a significant positive relationship between HCA scores and DIFF, $r(47) = .31$, $p < .05$. This suggests that 9% of the variance in dart throw average increase from practice to competition rounds could be explained by higher competitive attitudes.

An ANCOVA followed to remove the effects of the HCA covariate in examining the effects of cognitive training on dart throw average improvement from practice to competition rounds. ANCOVA results revealed that after partialling out the effects of the covariate (HCA), cognitive training was not significantly related to improvement in dart throw average from practice to competition round, $F(2, 45) = 1.59$, $p = .214$, $\eta^2_p = .066$.

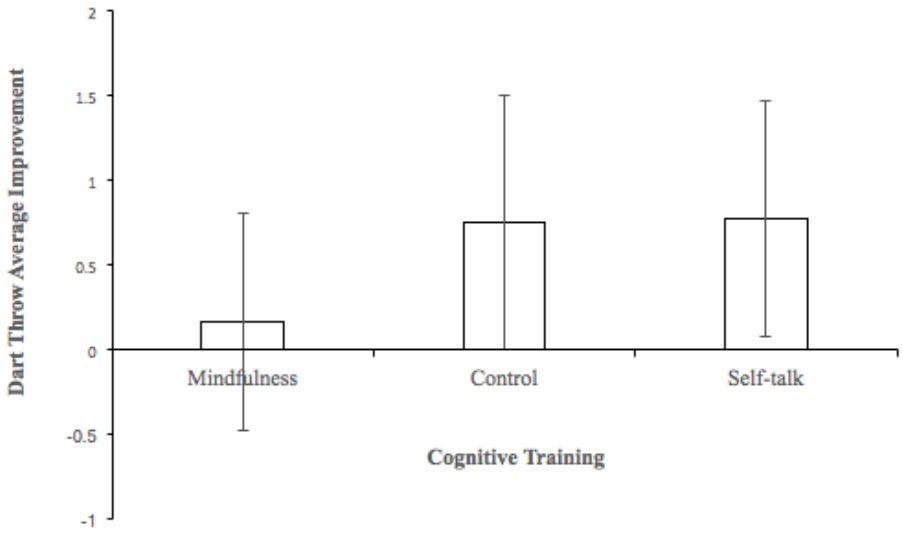

Figure 3. Dart Throw Average improvement from practice to competition rounds. Error bars show 95% CIs.

Considering that MM had the largest impact on the practice round, a Pearson's correlation analysis was conducted to determine if any linear relationships between trait mindfulness (and its subsets) and practice round dart throw average were present. The correlational analysis revealed a significant positive relationship between FFMQ (total) score and practice round dart throw average, $r(47) = .31$, $p < .05$, suggesting that 9% of the variance in practice round dart throw average could be explained by trait mindfulness.

An ANCOVA followed to remove the effects of the FFMQ covariate in examining the effects of cognitive training on practice dart throw average. ANCOVA results revealed that after partialling out the effects of trait mindfulness (FFMQ), cognitive training was not significantly related to improvement in dart throw average, $F(2, 45) = 1.95$, $p = .154$, $\eta^2_p = .080$. However, a moderate to large effect was identified. Refer to *State versus Trait Mindfulness* (p. 30) section in the discussion.

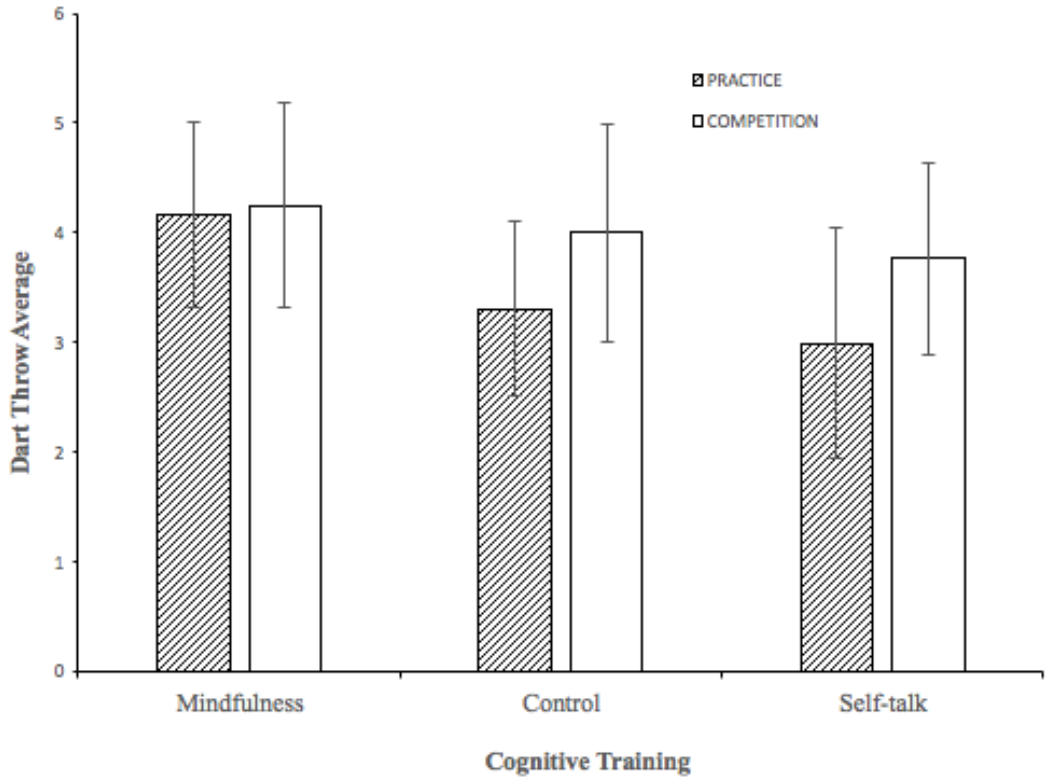

Figure 4. Dart throw average for cognitive training groups for practice and competition rounds. Error bars show 95% CIs.

Discussion

There were several key aims of the present study. The first was to investigate the effects of a 10-day mindfulness (MM) intervention compared to a 10-day self-talk (ST) intervention on dart throwing performance. The second aim of the current study was to do so within a cognitively loaded environment characteristic of competition – an element largely absent in prior research. The third aim was to account for prior shortcomings of ST research. Additionally, to account for the lack of control condition in previous research comparing PST to mindfulness intervention (i.e., Hasker, 2010), the current study added a control group (CTR) which consisted of participants engaging in 10-days of Lumosity brain game activities.

Aim 1: Performance on Practice round (cognitive load absent).

Based on existing empirical support for the effect of ST and MM on physical performance (Gardner & Moore, 2012; Hatzigeorgiadis, Zourbanos, Galanis, & Theodorakis, 2011; Perkos et al., 2002; Tanay et al., 2012), it was hypothesised that the intervention groups would outperform the CTR group in their dart throw average during the practice round. Therefore, the hypothesised pattern of results was: MM = ST > CTR. However, the first planned contrast between the intervention groups and the CTR group was non-significant. That is, the two intervention groups did not outperform the CTR group in the practice round, with the practice round results more closely resembling H_2 pattern, MM > CTR > ST. The second planned contrast, which compared practice dart throw average score between the two intervention groups, provided insight as to why this might be the case. It was predicted that the two intervention groups would score similarly (yet higher than CTR group) during the practice round. However, the second planned contrast revealed a moderate effect in the difference of mean scores between MM and ST group's dart throw average ($\eta^2 = .06$),

indicating that MM group had a higher dart throw average score than the ST group due to ST group's relatively low dart throw average during the practice round.

Given that cognitive load was absent during the practice round, it can be reasoned that ST group's lowest dart throw average score was not due to ironic effects. Ironic effects are said to occur when conscious cognitive capacity is limited, and result in an increase of unwanted cognitions and emotions (Clark et al., 1991). The present study's findings are inconsistent with previous research (Kolovelonis et al., 2012; Perkos et al., 2002), which found support for instructional ST for both skill acquisition (such as dart throwing) and performance of a well learned task (such as dribbling and passing). Instead, the present study's pattern of results is in accordance with Gardner and Moore's (2007) observation that attempts to control mental activity results in an increase of self-focused rather than task-focused attention. Specifically, the positive effect of MM on dart throwing performance – compared to the CTR group – adds further weight to Gardner and Moore's (2006) reasoning that mindfulness enhances metacognitive attention to relevant aspects of the environment and task at hand. Moreover, rather than focusing on inflexible rule systems, in which individuals direct their thoughts on what should or should not be done, MM allows the individual to experience a non-judging, metacognitive mindful absorption in the task, resulting in a stable and functional performance.

Aim 2: Performance on Competition round (cognitive present).

In line with Wegner's (1994) Ironic Process theory, a different pattern of results was hypothesised for the competition round which also included the variable of time limit to cognitively load participants. This variable was implemented through the use of a loud timer. The hypothesised pattern of results for the competition round was: MM > CTR > ST. While the general pattern of results for the competition round was in line with the expected pattern

(see *Figure* 2), the non-significant findings indicate that two key expected outcomes did not eventuate.

As displayed in *Figure 3*, practice effects were evident in the improvement of the ST group's dart average scores from practice to competition rounds. This was highly unexpected, and suggests that one of the key aims of the present study – elicitation of ironic processes – failed to occur.

One possible explanation for this finding is that during the group's 10-day ST training, participants were carefully instructed to create affirmation statements directing them in what *to* do, rather then what *not* to do (i.e. "*You are able to concentrate under pressure*" instead of "*Don't fumble under pressure*"). As evidenced from the qualitative data provided in the ST manipulation check (see Appendix N), all of the 15 participants who implemented their ST followed the instructions to create affirmation statements with the most commonly implemented cue word being "*focus"*. In this context, although ST participants were actively controlling their cognitions, they were not necessarily suppressing specific thoughts. This may have potentially buffered them from ironic effects previously reported (i.e. Wegner et al., 1998). However, Wegner (1994) proposes that similarly to suppression, concentration is a variable quantity, in that one is unable to ever concentrate perfectly, fully or continuously. As such, Wegner argues that concentration is also susceptible to ironic effects. This claim was supported in a Stroop colour-naming study, in which participants who were intentionally concentrating under mental load found distracters to be more accessible than the targets of concentration (Wegner, Erber, & Bowman, 1993). Important to note however, was that participants in the Stroop colour-naming study were not actively implementing any ST strategies, therefore the type of mental load used to elicit ironic effects of concentration was very cognitive in nature; participants were given a nine-digit number to hold in mind and recall at the end of their studying. Implementing that type of cognitive load to examine

mental control as carried out via implementation of ST would actively interfere with ST implementation. More importnatly however, giving participants cognitive information to hold in mind is not the type of cognitive load experienced in competition, and is therefore not pertinent to the current research question.

A further explanation for the absence of ironic effects in the present study may be attributed to common limitations associated with experimental research such as issues of external validity. Despite attempts to create a competitive high-stress environment, participants in the present study were asked to carry out a task which did not carry personal meaning or real-world implications. Therefore, this surface investment in the task may have buffered them against the artificially cognitively loaded environment, as running out of time to throw their nine darts did not impose any negative consequences.

Additionally, scores on the self-report Hypercompetitive Attitude Scale (HCA) suggest that the present study's sample was made up of relatively non-competitive individuals. In comparison to Ryckman et al.'s (1990) normative data, which was based on 642 undergraduate psychology students from the University of Maine (M = 71.87 – 72.02, SD = 12.18, 14.12), the present study's sample (M = 58.02, SD = 11.12) was almost a standard deviation below the mean in their levels of competitive attitude. Therefore, the lack of naturally competitive attitudes – as measured by the HCA – coupled with little personal investment in the task may have buffered ST participants against ironic effects. This therefore resulted in improved performance from practice to competition rounds due to practice effects.

Another plausible reason for the lack of significant findings in the competition round may be that the MM group did not not demonstrate much improvement from practice to competition rounds. As evidenced in *Figure 3*, the MM group showed the least amount of improvement from practice to competition rounds (M = .17, SD = 1.24, 95% CI [-.47, .80]) compared to CTR (M = .76, SD = 1.41, 95% CI [.00, 1.50]) and ST (M = .77, SD = 1.31, 95%

CI [.08, 1.47]) groups. One possible explanation for this is that a ceiling effect occurred. Vogt (2005) states that a ceiling effect can occur when a high proportion of participants attained maximum scores on the observed variable. As evident in the practice round results, most MM participants attained a high dart average throw, which may have prevented them from significantly increasing their dart throw average score during the competition round.

In addition, just as low competitive attitudes worked to buffer ST participants from ironic effects, low competitive attitude scores (as measured by the HCA) may have accounted for lack of improvement from practice to competition rounds for the MM group. Considering that a positive correlation between competitive attitude and improvement in score from practice to competition rounds was found (r = .31), this would suggest that the MM group reported lowest levels of competitive attitude. Surprisingly, findings revealed to be in direct contrast with that assumption, as the MM participants reported highest levels of competitive attitude, followed by CTR group, with ST participants reporting the lowest. Such findings would allow us to infer that MM group's lack of improvement from practice to competition rounds is better explained by ceiling effects rather than lack of competitive attitude.

Overall performance

Taking into consideration the pattern of results for both practice and competition rounds (see *Figure 4*), it was found that MM had an overall positive effect on dart throwing performance. However, the data revealed that the largest variance of performance occurred during the practice round. This indicates that MM may be most beneficial in the early stages of skill acquisition. As a large part of mindfulness training is a non-judgemental acceptance of the current experience, it has been suggested that such a mindset facilitates learners' early stages of skill acquisition as it allows them to accept any incoherencies or inconsistencies encountered (Langer, 2000). Findings from previous research have revealed that even

following a short mindfulness intervention, participants were able to increase their movement variability during practice, resulting in faster motor skill acquisition (Kee, Chaturvedi, Wang, & Chen, 2013). According to Kee and colleagues, mindfulness training allows individuals to vary their existing movement repertoire to explore a new, more desirable movement pattern. In the context of the present study (where participants were given clear instructions on dart throwing), the MM group's higher practice dart throw average may be attributed to participants' ability to make quicker adjustments to implement instructions given (i.e. posture, dart grip, throwing speed). Therefore, resulting in increased dart throw accuracy.

State versus Trait Mindfulness

Although there were no statistically significant differences between the three groups' levels of trait mindfulness upon arrival on testing day, it is worthy of mention that MM group reported highest levels of trait mindfulness. Kiken, Garland, Bluth, Palsson and Gaylord (2015) found that increasing state mindfulness over repeated mindfulness meditation sessions results in an increase of trait mindfulness. Considering that the FFMQ was completed by participants following their 10-days of cognitive training, it is plausible that MM participants experienced variation in their trait mindfulness. As a relationship between trait mindfulness and flow state has previously been established (i.e. Cathcart, McGregor, & Groundwater, 2014), this may explain why a positive relationship between FFMQ and practice dart throw average was found. It is possible that the MM training facilitated flow – a state which researchers argue assists novices in motor skill acquisition as it represents heightened awareness, task-relevant concentration and loss of self-consciousness (Csikszentmihalyi, 1990; Gardner & Moore, 2007). Ceiling effects however may have prevented a demonstration of improved dart throw average during competition round.

Control versus acceptance of mental state.

Previous studies suggest that ideal performance state is achieved through self-control over internal states (Weinberg & Gould, 2015; Whelan et al., 1991). In the present study, the pattern of results suggest that control over internal state may be both unnecessary and unrelated to enhanced athletic performance. Considering that the CTR group had an overall higher dart throw average than the ST group, this suggests that controlling one's cognitions may actually result in impaired performance, regardless of ironic effects. Gardner and Moore (2004) argue that control based approaches result in overly cognitive (self-focused, verbal-semantic) activity, resulting in a reduced capacity for automatic engagement, a reduction of appropriate response to necessary contextual cues, as well as reduced capacity to maintain task-relevant attention.

Aim 3: Prior concerns regarding ST research

The application of prescribed ST in previous research, which was often scripted by the researchers, was identified as a major shortcoming by Harvey et al. (2002). Moreover, participants' unfamiliarity with the prescribed ST negatively impacted their ability to implement ST strategies and consequently, affected the laboratory study outcomes. In the context of the present study, ninety-four percent of the ST participants found their self-assigned ST both very useful and easy to implement (see Appendix J). Based on this finding, it can be inferred that the present study redressed the shortcomings of prior ST research. The present study's results are therefore a true representation of ST implementation, and suggest that implementiation of ST may be unrelated to enhanced performance.

Practical Implications

Despite not reaching statistical significance, practical implications may still be drawn from the present findings. The pattern of results highlighted the benefits of MM during the practice round, indicating that MM may be most beneficial in the early stages of skill acquisition. In addition, the present study's sample consisted of relatively non-competitive individuals. As such, these findings suggest that MM is best applied among non-competitive populations – such as students – within the educational setting. For example, in the context of teaching students new motor skills, physical educators may consider implementing MM based interventions to foster their students' non-judging, metacognitive mindful absorption of set tasks (Gardner & Moore, 2006). In addition, ongoing MM training may facilitate a state of flow, during which heightened awareness, task-relevant concentration and loss of self-consciousness can assist students in motor skill acquisition (Csikszentmihalyi, 1990; Gardner & Moore, 2007).

The duration over which MM is implemented is also critical. The present study found that trait mindfulness was correlated with increased dart throw average during the practice round. Increasing trait mindfulness, as identified by previous research (i.e. Kiken et al., 2015), is achieved through increasing state mindfulness over repeated MM sessions. Kiken et al. (2015) specifically suggested that MM interventions should take place over a period of at least 8 weeks to account for variability in individual rates of change in state mindfulness.

As noted by Bishop et al. (2004), MM practise fosters curiosity, openness and acceptance, and importantly, enhanced skills in sustained attention. Therefore, the practise of MM may not only assist with motor skill acquisition, but also promote overall academic engagement and performance. According to Langer (2000), learning mindfully enhances a creative cognitive process which allows for deeper level processing to occur. Although Langer's concept of mindfulness differs from the present study's concept of mindfulness – as

described in the context of mindfulness meditation – both constructs involve a specific nature of attention which results in greater sensitivity to context and perspective.

As Shapiro et al. (2010) observed, intentionally attending in a non-judgmental and open way – through engaging in MM – leads to a significant shift in perception (reperceiving), which directly affects self-regulation and enhances cognitive, emotional and behavioural flexibility. MM has therefore been linked to improved emotional regulation, which is a fundamental component of well-being. Modinos, Ormel and Aleman (2010) further found that individual differences in the ability to regulate emotional responses were related to differences in trait mindfulness. Based on these studies, it is reasonable to suggest that increasing students' levels of trait mindfulness through increasing their state mindfulness (over repeated MM sessions) may lead to enhanced emotional regulation and well-being. Despite well-being not being a dependent variable of the present study, evidence from severeal studies linking trait mindfulness and well-being adds further empirical weight to the notion that MM training – which, in the present study, may have influenced trait mindfulness – has important practical implications on wellbeing (Grossman, Niemann, Schmidt, & Walach, 2004; Krygier et al., 2013; Modinos et al., 2010). According to Mission Australia (2017), there has been a significant increase in the number of youth experiencing issues such as coping with stress, school or study problems and depression. In this context, the skill of MM may be an invaluable tool for the student population to learn, particularly during times of adversity.

Limitations

In designing the present study, the researchers sought to redress key limitations identified in previous research: (1) biases associated with self-report data; (2) lack of a control condition; and (3) researcher-developed rather than participant developed ST.

Nonetheless, the present study is not without its own limitations. Firstly, as SMS results were only obtained from the MM group, the ST and CTR participants' levels of state mindfulness could not be determined. While comparisons to both Lueke and Gibson (2016) and Tanay et al.'s (2012) reported SMS scores allowed the present study to infer that its MM intervention was indeed successful, there is no conclusive confirmation that MM participants were higher in state mindfulness than the CTR and ST participants. In addition, the present study's ST manipulation check was based on previous research by Kolovelonis, Goudas and Dermitzaki (2011) – a study designed without a control condition. Subsequently, the present study's ST manipulation check was created specifically for participants who had undergone ST training, and was therefore not administered to MM and CTR groups. Although the ST manipulation check indicates that the present study's ST manipulation was successful (for 94% of the ST participants), we cannot determine whether or not individuals in the CTR and MM groups were implementing some kind of ST automatically. Therefore, any conclusions based on the current study can only be tentative at best.

In addition, although the "Thinkific" website allowed the researchers to track participants' daily progress in terms of percentage achieved, a mere click of the "next" button increased participants' daily percentage amount. Therefore, there is no way of determining whether the instructions were carried out in a disciplined fashion. Due to ST participants being asked to physically fill out answers to set homework tasks (see Appendix F), this limitation is more relevant to the MM intervention. Therefore, the only MM training the researchers can be certain was administered, was the 6-minute "top-up" received during testing session. Future research may benefit from using either diary self-monitoring method (Burke, Wang, & Sevick, 2011) or the experience sampling method (Csikszentmihalyi & Larson, 1987) for a more comprehensive measure of participants' behavioural adherence to the MM training. Moreover, although the power analysis (using G*Power 3.1.9.2 based on

previous research) suggested sample size of 52 was originally attained, our removal of "expert" dart players reduced our final sample size. Therefore, given the small sample size, findings again can only be tentative. In addition, all psychological factors were measured via self-report inventories, and therefore responses may have been affected by social desirability, memory bias and measurement effects (Podsakoff, MacKenzie, & Podsakoff, 2012). Future research may benefit from including biomarkers (such as heart rate variability [HRV]) for a more objective measure of trait mindfulness, as changes in normalised HRVfollowing MM have been found (Krygier et al., 2013). Additionally, scores on the self-report HCA suggest that our sample was made up of relatvely non-competitive individuals. Therefore, our findings cannot be generalised to the athletic community.

Conclusion

In summary, the present study provided initial evidence supporting the application of mindfulness meditation intervention training in dart throwing performance. Specifically, mindfulness training appeared to be most beneficial in the early stages of skill acquisition. In addition, given the control group outperformed the self-talk group in both practice and competition rounds, our findings suggest that controlling one's mental state may be unnecessary and unrelated to enhanced athletic performance. Considering our noted limitations and lack of significant findings however, any conclusions drawn can only be tentative at best.

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Appendices

Appendix A - Ethics approval letter

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

26 May 2017

Mr Peter Tranent
Division of Psychology
University of Tasmania

Student Researcher: Stefania Franja

Sent via email

Dear Mr Tranent

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0016567 - Effects of Self-talk Vs. Mindfulness Intervention on Physical Performance (Cognitive Training and Physical Performance)**

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Deputy Chair of the committee considered and approved the above project on 26 May 2017.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

Appendix B - Participant information sheet

Effects of Cognitive Training on Physical Performance

Participant Information Sheet

Invitation

You are invited to participate in an experiment examining the effects of cognitive training on motor task performance. The research is being conducted by Stefania Franja under the supervision of Peter Tranent, in partial fulfilment of an Honours Degree at the University of Tasmania. The researchers can be contacted as follows: Stefania Franja (sfranja@utas.edu.au; Ph: 03 6324 3293) and Peter Tranent (Peter.Tranent@utas.edu.au; Ph: 03 6324 3293).

What is the purpose of this study?

The purpose of this study is to test two different types of cognitive training on performance of a motor skill.

Why have I been invited to participate?

We are seeking volunteers who are aged between 18 and 65 who feel confident that they can attempt a very basic motor task which does not require any prior knowledge or training.

What will I be asked to do?

You will be asked to engage in 5-minute cognitive training online to be competed for 10 days consecutively, followed by coming in to attend a 20-minute testing session at Discipline of Psychology, UTAS, Launceston campus. You will be asked to fill out some questionnaires assessing your personality type before being given a 5-minute practice period to familiarize yourself with the set motor task. Following this, you will be asked to listen to a 10-minute cognitive training recording. After your physical practice and cognitive training, you will be asked to perform motor task and your results will be documented.

Are there any possible benefits from participation in this study?

Your participation will help us enhance our knowledge of the effects of different types of cognitive training on performance outcome. This knowledge can be used to educate people about the potential benefits of cognitive training as well as informing further research in the area around psychological skills training in sports. If any indication of one cognitive training group being more advantageous over the other arises, you as a participant will have full access to such cognitive training for 1 month to follow. Best three performances will win cash prizes of $80 (first place), $50 (second place) or $20 (third place). Psychology KHA111/KHA112 are eligible for course credit of 50 minutes for online cognitive training participation, after which you will be invited to participate in on-campus testing participation for which you will get additional course credit of 30 minutes. Non KHA111/KHA112 students will go into a draw to win a Woolworths vouchers worth $100.

Are there any possible risks from participation in this study?

We are not expecting there to be any associated risks or harm for participants engaging in cognitive training. We do not anticipate that completing the motor task would induce any stress, however, it is noted that the testing of performance in a slight competitive setting

may cause low levels of anxiety for which we will offer a debriefing session. However, if further support is needed, freely available counselling services for current students are available at the University of Tasmania (Launceston: 03 6324 3787; Cradle Coast: 03 6430 4947). For other support, there are free 24hr counselling services available on the Mental Health Hotline: 1800 332 388 (Tasmania) or Lifeline: 13 11 14 (National).

What if I change my mind during or after the study?

There is no pressure for you to take part in this research project, you are free to withdraw at any time without provision of explanation, and there will be no consequences if you choose to do so. If you choose to withdraw from the study, any data that you may have provided will be removed from the study.

What will happen to the information when this study is over?

Data collected during the study will be stored on a password protected computer system within the University of Tasmania. The information will only be used for this specific research project. This will include an honours thesis and a presentation and possible publication in an academic journal. In these publications and presentations your data will be de-identified and you will remain anonymous.

How will the results of the study be published?

You may request a copy of the final results when the research has been completed. A summary of the findings will be posted on the Division of Psychology's research page (http://www.utas.edu.au/psychology/research). You will not, however, have access to your individual data, nor will you be identifiable in the publication of the results.

What if I have questions about this study?

If you have further questions about the study that have not been answered here please contact the head researcher; Mr. Peter Tranent Peter.Tranent@utas.edu.au. This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number **H0016567.**

Appendix C - Participant consent form

Effects of Mindfulness Intervention Vs. Self-talk on Motor Task Performance

Participant consent form

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.
4. I understand that the study involves a commitment of 50 minutes of online cognitive training over ten days, as well as a 20-minute testing session where I will be given a motor task to practice and perform, as well as a ten-minute cognitive training session.
5. I understand that participation may involve low levels of performance anxiety which will be mitigated by a debriefing session as well as information on free and available counselling services.
6. I understand that all research data will be securely stored on the University of Tasmania premises for five years from the publication of the study results, and will then be destroyed and that all my data will be de-identified and I will remain anonymous.
7. Any questions that I have asked have been answered to my satisfaction.
8. I understand that the researcher(s) will maintain confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research.
9. I understand that the results of the study will be published so that I cannot be identified as a participant
10. I understand that my participation is voluntary and that I may withdraw at any time without any effect.

    If I so wish, I may request that any data I have supplied be withdrawn from the research until 01/08/2017

Participant's name: _____

Participant's signature: _____

Date: _____

Statement by Investigator

☐ I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator's name: _____

Investigator's signature: _____

Date: _____

Appendix D - Recruitment flyer

UTAS

Research Volunteers Wanted

Effects of Cognitive Training on Physical Performance

Are you aged between 18-65 years?

Do you like competition?

We are looking for volunteers who feel confident they can attempt a very basic motor task which does not require any prior knowledge or training!

As a participant, you will be given access to a **cognitive training program** which you will be required to engage in daily (5 min a day) for 10 consecutive days.

You will then be required to attend a short 20 min on-campus testing session for *The Competition*.

Cash Prizes (1st$80, 2nd$50, 3rd$20) awarded for top 3 performances!

ALL PARTICIPANTS GO INTO DRAW TO WIN WOOLWORTHS VOUCHERS!

If interested please email:

Cognitivetrainingresearch@gmail.com

Appendix E - 10-day mindfulness mediation instructional audio transcript

Day 1

[AUDIO] *In this set of exercises, you will learn to relax and concentrate on your breath without stretching any muscles. The following exercises pertain to mindfulness training and are limited to developing mindfulness of breathing. These are important exercises that will prepare you for mindfulness of body sensations. They will also help you relax further without any stretch, wherever you are, at work, with your family, alone, even in bed. You will learn to become aware straightaway of all conscious and perhaps subconscious activities in the mind which often affect our breath. Being able to observe the breath and have a degree of control over our reactivity or attitude towards the breath is important because it teaches us self-control, not just relaxation. These exercises will also help in developing a degree of concentration in your mind. Often our mind is busy, stressed, and ruminative, which means that we repeat over and over negative or unhelpful thoughts. This exercise will help you focus and remain focused.*

So let us start now with the practice… Sit comfortably in a chair which keeps your back straight. Your neck must also be kept straight. Next, neck straight, back straight, comfortably seated, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.

If the air in the environment is very warm or very cold, you may feel the temperature of the air, touching the outer ring or the inner walls of the nostrils, and at other times you won't. That's ok. Then be simply aware that the air is flowing continuously at the entrance of your nostrils…… Notice if it comes more though the left or right nostril...if it is deep or shallow… fast or slow. When you are aware of the incoming and outgoing breath, there is no past or future…you are in the present moment, from moment to moment... Time almost doesn't exist.

Your mind is not used to staying in the present moment. It is used to wandering…in the past, in the future, but very rarely stays in the present moment… There are reasons why this occurs. When parts of the brain are constantly activated, by habit or because there is a memory that is more or less stressful, the strength of this activation in the brain is such that we tend to repeat the thought or the memory. And because of this repetition, these pathways in the brain are facilitated and the thoughts related to these pathways keep on intruding. They keep on intruding over and over and over again, until you stop nurturing them by not

thinking them… Your big challenge during this exercise is to withdraw your attention from any ongoing thought, understanding this is just a thought.

Keep breathing consciously_. Very alert, very attentive… Every time a thought arises, see it for what it is, just a thought. Not the truth, not you… Although there may be true issues within that thought, the thought is just a thought… Learn to see thoughts for what they are. Practice now for a few minutes, to see thoughts for what there are, without reacting or engaging with them, without identifying yourself with them…with a degree of detachment. And look at the incoming and outgoing breath, as it comes in, as it goes out. Do your best.

One minute silence

Thank you for your work today. [AUDIO END]

Day 2

[AUDIO] *Let us start with the practice… Sit comfortably in a chair which keeps your back straight. Your neck must also be kept straight. Next, neck straight, back straight, comfortably seated, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath..*

Be simply aware that the air is flowing continuously at the entrance of your nostrils…… Notice if it comes more through the left or right nostril...if it is deep or shallow… fast or slow_. When you are aware of the incoming and outgoing breath, there is no past or future…you are in the present moment, from moment to moment... Time almost doesn't exist.

One minute silence

Keep on focusing steadily on the in and outgoing breath… trying to sustain your attention towards your breath for as long as you can_ _ _. There is no need to count or to put any strategy into your mind because you would focus on the strategy and forget about the breath… You might start saying "one two, one two" or "in out, in out" and forget all about what you are actually doing… So just observe what actually happens rather that thinking about what happens_. Learn about your or mind by focusing on your breath, from moment to moment, without judging, evaluating, or reacting to the experience…

Keep practising. The longer you practise, the more changes you will notice in your daily activities or you will be able to focus better, gain time on the job, be less bothered by intrusive thoughts, and develop a degree of self-confidence and self-control..

One minute silence

Thank you for your work today. [AUDIO END]

Day3

[AUDIO] *Let us start with the practice… Sit comfortably in a chair which keeps your back straight. Your neck must also be kept straight next. Neck straight, back straight, comfortably seated, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath..*

Maintain the practice steadily, focusing on your incoming and outgoing breath… Every time your mind wanders, do not feel disappointed or defeated. Bring it back smilingly to the awareness of respiration, at the entrance of the nostrils... and keep on developing your awareness of breath… mastering your own mind, bit by bit, progressively… Keep practising confidently.

You may be able to feel a sensation of cold on the inner walls of the nostrils as you breathe in, and maybe a little sensation of warmth on the inner walls of the nostrils as you breathe out, and maybe a little feeling of the air touching the skin below the nostrils on the area above the upper lips, on the area of the moustache… If you don't feel anything, breathe slightly harder for a few seconds just to feel the touch of the breath and then quickly come back to normal breathing, natural breathing. Remember we are not trying to regulate the breath, we are just observing and accepting it as it is..

Observe what actually happens rather that thinking about what happens by focusing on your breath, from moment to moment, without judging, evaluating, or reacting to the experience…

The next few minutes will be in silence to allow you to practise without interruption. You will hear my voice again at the end of the meditation. Do your best.

3 minute silence

Thank you for your work today [AUDIO END].

Day 4

[AUDIO] *Sit comfortably in a chair which keeps your back straight. Your neck must also be kept straight. Neck straight, back straight, comfortably seated, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.*

Being simply aware that the air is flowing continuously at the entrance of your nostrils…… Notice if it comes more though the left or right nostril...if it is deep or shallow… fast or slow_. When you are aware of the incoming and outgoing breath, there is no past or future…you are in the present moment, from moment to moment... Time almost doesn't exist.

Keep breathing consciously. Very alert, very attentive… Every time a thought arises, see it for what it is, just a thought. Not the truth, not you… Although there may be true issues within that thought, the thought is just a thought… Learn to see thoughts for what they are.

Practice now for a few minutes, to see thoughts for what there are, without reacting or engaging with them, without identifying yourself with them…with a degree of detachment. And look at the incoming and outgoing breath, as it comes in, as it goes out. Do your best.

1 minute silence

Sometimes your mind will wander because it doesn't like to stay in the present moment; it is not used to it… It will wander either in the past or in the future, bring it back to the present moment… smilingly… without resenting the fact that it has wandered despite your effort to keep it steady… Each time it wanders, gently bring it back to the awareness of respiration..

Keep on focusing on the in and outgoing breath, trying to sustain your attention for as long as you can.

The next few minutes will be in silence to allow you to practise without interruption. You will hear my voice again at the end of the meditation. Do your best.

2 minute silence

Thank you for your work today. [AUDIO END]

Day 5

[AUDIO] *Sit comfortably in a chair which keeps your back straight. Your neck must also be kept straight next. Neck straight, back straight, comfortably seated, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.*

Being simply aware that the air is flowing continuously at the entrance of your nostrils……

You may be able to feel a sensation of cold on the inner walls of the nostrils as you breathe in, and maybe a little sensation of warmth on the inner walls of the nostrils as you breathe out, and maybe a little feeling of the air touching the skin below the nostrils on the area above the upper lips, on the area of the moustache… If you don't feel anything, breathe slightly harder for a few seconds just to feel the touch of the breath and then quickly come back to normal breathing, natural breathing. Remember we are not trying to regulate the breath, we are just observing and accepting it as it is.

When you are aware of the incoming and outgoing breath, there is no past or future…you are in the present moment, from moment to moment... Time almost doesn't exist.
Keep breathing consciously… very alert, very attentive... Every time a thought arises, see it for what it is, just a thought…in the present moment, from moment to moment… …

Some of you may already feel sensations somewhere around the nose perhaps, on the face, or elsewhere on the body. This is normal. Whether they are pleasant or unpleasant, feeling these sensations are absolutely normal… The more relaxed you are, the more sensitive to your processes you become, because you are not distracted… …
Very alert, keep on focusing consciously on the in and outgoing breath for as long as you can. The more you practise, the more benefits, immediate benefits.
The next few minutes will be in silence to allow you to practise without interruption. You will hear my voice again at the end of the meditation. Do your best.

3.5 minute silence

Thank you for your work today. [AUDIO END]

Day 6

[AUDIO] *Let us start with the practice… Sitting comfortably in a chair and keeping your back and neck straight. Now that you are comfortably seated with you neck straight and back straight, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.*

Your mind will wander because it doesn't like to stay in the present moment; it is not used to it… It will wander either in the past or in the future, bring it back to the present moment… smilingly… without resenting the fact that it has wandered despite your effort to keep it steady… Each time it wanders, gently bring it back to the awareness of respiration.

Observing rather than thinking about what happens by focusing on your breath, from moment to moment, without judging, evaluating, or reacting to the experience…

If you feel sensations somewhere around the nose or, on the face, or elsewhere on the body, remember, this is normal. Whether they are pleasant or unpleasant, feeling these sensations is absolutely normal… The more relaxed you are, more sensitive to your processes you become, because you are not distracted.
Keep on focusing consciously on the in and outgoing breath for as long as you can. The more you practise, the more benefits, immediate benefits.
The next few minutes will be in silence to allow you to practise without interruption. You will hear my voice again at the end of the meditation. Do your best.

4 minute silence

Thank you for your work today. [AUDIO END]

Day 7

[AUDIO] *Let us start with the practice… Sitting comfortably in a chair and keeping your back and neck straight. Focusing all your attention at the entrance of your nostrils. Being aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.*

Practice now for a few minutes, to see thoughts for what there are, without reacting or engaging with them, without identifying yourself with them…with a degree of detachment. And look at the incoming and outgoing breath, as it comes in, as it goes out. Take the next few minutes in silence to practise. You will hear my voice again at the end of the meditation. Do your best

5 minute silence

Thank you for your work today. [AUDIO END]

Day 8

[AUDIO] *Sitting comfortably with you neck straight and back straight, let us start the practise. Focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.*

You may be able to feel a sensation of cold on the inner walls of the nostrils as you breathe in, and maybe a little sensation of warmth on the inner walls of the nostrils as you breathe out, and maybe a little feeling of the air touching the skin below the nostrils on the area above the upper lips. If you don't feel anything, breathe slightly harder for a few seconds just to feel the touch of the breath and then quickly come back to normal breathing, natural breathing. Remember we are not trying to regulate the breath, we are just observing and accepting it as it is

We will have a few minutes of silence to practise now, to see thoughts for what there are, without reacting or engaging with them, without identifying yourself with them…with a degree of detachment. If your mind wanders just bring it back to the present moment. Smilingly, without resting the fact that it has wondered despite your efforts to keep it steady. You will hear my voice again at the end of the meditation. Do your best.

6 minute silence

Thank you for your work today [AUDIO]

Day 9

[AUDIO] *Sitting comfortably with you neck straight and back straight, let us start the practise. Focusing all your attention at the entrance of your nostrils and being aware of the breath coming in, going out.*

Focusing on your incoming and outgoing breath. Keep practising. Every time your mind wanders, do not be disappointed or defeated. Bring it back smilingly to the awareness of respiration, at the entrance of the nostrils.

Keep developing awareness of breath; mastering your own mind, bit by bit, progressively.

When you are aware of the incoming and outgoing breath, there is no past or future…you are in the present moment, from moment to moment... Time almost doesn't exist. Keep breathing consciously… very alert, very attentive... Every time a thought arises, see it for what it is, just a thought…

Practice now for a few minutes. You will hear my voice again at the end of the meditation. Do your best.

6 minute silence

Thank you for your work today [AUDIO]

Day 10

[AUDIO] *Sitting comfortably with you neck straight and back straight, let us start the practise. Focusing all your attention at the entrance of your nostrils and being aware of the breath coming in, going out. Keep breathing consciously. Very alert, very attentive… Every time a thought arises, see it for what it is, just a thought. Not the truth, not you…*

Today you have the opportunity extend your practise, to build on the last 9 days of work and extend your meditation.

*Maintain your practise steadily, focusing on your incoming and outgoing breath... Every time your mind wanders, do not feel disappointed or defeated***.**

Very alert, keep on focusing consciously on the in and outgoing breath for as long as you can.

Practice now for a few minutes. You will hear my voice again at the end of the meditation. Do your best.

8 minute silence

Thank you for your work today. [AUDIO]

Testing day

[AUDIO] *Sit comfortably in a chair with your back and neck straight. Neck straight, back straight, comfortably seated, focus all your attention at the entrance of your nostrils. And be aware of the breath coming in, going out, simple breath, mere breath, only breath, your own breath.*

Maintain your practise steadily, focusing on your incoming and outgoing breath... Every time your mind wanders, do not feel disappointed or defeated. Gently bring it back to the awareness of respiration.

You may be able to feel a sensation of cold on the inner walls of the nostrils as you breathe in, and maybe a little sensation of warmth on the inner walls of the nostrils as you breathe out, and maybe a little feeling of the air touching the skin below the nostrils on the area above the upper lips, on the area of the moustache...

Keep on focusing on the in and outgoing breath, trying to sustain your attention for as long as you can. The more you practise, the more benefits, immediate benefits.

Practice now for a few minutes. You will hear my voice again at the end of the meditation. Do your best.

5 minute silence

Thank you for your work today. [AUDIO]

Appendix F – 10-day self-talk instructional audio transcript and written instructions for homework exercises

DAY 1

What is self-talk?

[AUDIO] Welcome to your self-talk training guide. Each day you will be taken through a few short, exercises to help you implement this very simple skill into your everyday life [AUDIO END]

"When you step into the water, you have to tell yourself a thousand times "'I can swim the channel. I can swim the channel'", I can't tell you how many times over the past year, two years, I have said that to myself."

[AUDIO] This is an example of an athlete's self-talk on preparing to swim the English Channel, a distance of approximately 43 kilometres. What athletes think or say is critical to their performance. Unfortunately, the conscious mind is not always an ally. Although we all spend vast amounts of time talking to ourselves, most of the time we are not even aware of this internal dialogue, much less its content. Nevertheless, thoughts directly affect feelings and ultimately, our actions. So, it is unsurprising that inappropriate or misguided thinking will lead to negative feelings and poor performance, whereas appropriate or positive thinking leads to enabling feelings and good performance. The cognitive training that you will be guided through over the next ten days is aimed at enhancing your levels of control over your thoughts. This is the key outcome of self-talk strategies. You will have an opportunity to examine the current content of your thoughts, to identify any negative thoughts, which you will be encouraged to replace with more useful statements [AUDIO END]

Take the next minute to jot down 5 instances where your thoughts to yourself were negative in nature, while you were trying to accomplish a task. How did you feel? What was the outcome?

**The answers you provide here are for your use only, and will not be accessed by the researchers

Take another minute to jot down a time that you remember where your self-talk was positive while you were accomplishing a task. How did you feel? What was the outcome?
**The answers you provide here are for your use only, and will not be accessed by the researchers

Thank you for your work today.

DAY 2

Identifying the content

[AUDIO] Today we will examine the nature of your automatic self-talk as this is a necessary step towards changing automatic thoughts. Firstly, think back to the list of automatic negative statements that you made yesterday. Can you see any repeated themes, or particular emotional tones of your self-talk?
Think back to the statements that you listed yesterday, and attempt to break down their meaning and tone. For example, does your negative self-talk revolve around your own abilities, or others letting you down? Or perhaps things just never working out the way you want them to? [AUDIO END]
Are there re-occurring themes?
How rational do you believe them to be? For example, are there many "always" and "never" statements? Although commonly used, these are rarely true.
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And lastly, can their validity be challenged? Take a moment to address some of your negative statements, and really challenge them. Just because you have thought them, it does not make them true.

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Thank you for your work today.

DAY 3

Thought Stopping/ Monitoring

[AUDIO] Perhaps the best way to cope with negative thoughts is to stop them before they even occur or snowball out of control, harming your performance.

Today we will learn about Thought stopping, which involves concentrating on the undesired thought for a moment, and then using a cue or trigger to stop the thought from continuing and to clear your mind. A trigger can be as simple as saying "stop" or an action such as snapping your fingers or hitting your hand against your thigh. What makes the most effective cue really depends on the person, so you should explore what works best for you.

Take a minute to allow one of your familiar negative thoughts to come into your mind, and then attempt to stop it before it is complete. Use a word, or an action, whatever feels right.

[AUDIO END]

List your cue word or action here. Then take a moment to practise thought stopping a couple of times before going on to the next audio.

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[AUDIO] Thought stopping is a very useful skill, and is essential for thought control.

However, as it is very easy to slip back into old habits, thought stopping must be practiced

often as possible. Although at first you may need to say "stop" out loud, or snap your fingers, once you have mastered this, try saying "stop" quietly, to yourself, as this will allow you to implement this without self-consciousness in public [AUDIO END].

Thank you for your work today.

DAY 4

Replacing negative statements with positive statement.

[AUDIO] Welcome to today's lesson where we will focus on replacing negative statements with positive statements. This has been referred to as "cognitive restructuring". We all have automatic thoughts which can occur without us being conscious of them. Therefore, the goal here is to replace anxiety inducing thoughts with constructive, problem-solving self-talk. [AUDIO END].

An important element of restructuring your thoughts is how you refer to yourself. Much research over the years has illustrated the benefit of using language to enhance "self-distancing", which is a process that allows one to think objectively about irrational thoughts. For example, instead of a statement using the word "I" try replacing it with "you", so a statement such as "You can do this" is more effective than "I can do this". In fact, some athletes even tend to use their name as though they are talking to themselves in the third person to increase self-distancing.

Take a moment to list 5 negative statements that hurt your performance or that produce other undesirable behaviors. The goal is to recognize which situations produce negative thought and why.

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Previously, you have questioned the validity of your thoughts as well as practiced thought stopping. Now you can try to find a replacement statement for each negative statement.

<u>For example:</u>

Change a statement such as “you idiot- how could you miss such an easy shot?” to a more useful statement such as “everyone makes mistakes- just concentrate on the next point.” Take a few minutes to do this for each of your listed negative statements.
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[AUDIO] As most negative thoughts will occur under stress, practice halting the negative thought with the thought stopping trigger word implemented yesterday, then take a deep breath. As you exhale, repeat the positive statement. Thank you for your work today. [AUDIO END]

DAY 5

Building self-efficacy

[AUDIO] Hi, and welcome to today’s lesson on building self-efficacy. Self-efficacy is the belief that you are competent and able to perform efficiently and effectively. Creating thoughts that enhance your self-efficacy will ultimately lead to behaviour which is in line with those beliefs. Although sometimes instructive statements are already given to athletes, they are much more powerful and useful if they are specific to you. Therefore, with some of these following tips in mind, take a few minutes to jot down a list of statements that will assist you in your performance of a given physical task. [AUDIO END]
For example, “you get better at things you practise” or “you have a steady hand”
It is important that you keep your phrases short and specific.
Again, remember to use the self-distancing technique of replacing “I” with “you”. This is an important self-regulatory tool which decreases anxiety. Also, make sure your statement is in present tense, and that it is positive in nature.
When you say your phrases, do so with meaning and attention. Always speak kindly to yourself, and repeat your phrases often so they become automatic.

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Thank you for your work today.

DAY 6
Using statements to provide self-reward.

[AUDIO] Hi and welcome to today's lesson on using statements to provide self-reward. Although simply eliminating negative self-talk is important, research has indicated that adding self-feedback to instructional self-talk has the ability to enhance both concentration and performance. Providing feedback when you are trying to learn a new skill can improve your performance as it allows you to become more involved in the learning process. Now we will try a simple little exercise. [AUDIO END]

- Grab a lined piece of paper and a pencil.
- Now, try to write your name, address and phone number on it with your non-dominant hand. The goal is to make it as legible as possible, staying within the lines.
- Any time you write a digit or a letter correctly, practise saying yes, good, or ok.
- Whenever you make a mistake, practise saying no or bad.
- Keep providing this feedback in a gentle, positive way.
- When you are finished with the task, reward yourself with a statement.

Think back to a time when you have accomplished a task that was challenging, nerve racking, or just something you did not feel like doing. Did you take a moment to congratulate yourself?

Recognising your effort with a rewarding statement is useful for enhancing motivation.

List a couple of instances where you have implemented positive self-talk this week and followed through with your task. Now take a moment to type in a couple of rewarding statements, recognizing your effort. Remember to:

- Make them specific
- Say them with meaning and attention

Thank you for your work today.

DAY 7

Revision

Today we will combine what you have learned over the first few days into one activity. Repeating this process will make it more automatic and less effortful.

Take a moment to list any negative thoughts which occurred throughout your day.

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Now attempt to identify their content and their tone.

*The answers you provide here are for your use only, and will not be accessed by the researchers)

Looking over these negative thoughts, question their validity. Is the list the same as it was a few days ago? Are there re-occurring themes?

Whether they are new or old negative thoughts, replace each negative thought with a positive statement.

*The answers you provide here are for your use only, and will not be accessed by the researchers)

Thank you for your work today.

DAY 8

[AUDIO] Today we will review and practice thought stopping.
Take a moment to consider any negative thoughts that you have experienced over the past few days. (pause). Take a minute to allow one of your familiar negative thoughts to come into your mind, and then attempt to stop it before it is complete. Think back to your cue word for thought stopping, and implement it to stop your negative thought. [AUDIO END]

Practice this again with another negative thought, as repeating this process will make it more automatic and less effortful. Once the trigger word has cleared your mind, take a deep breath and focus on one of your positive statements.
Thank you for your work today.

DAY 9

Development of Affirmation Statements

[AUDIO] The difference between an Affirmation statement and one of the earlier positive statements is that the affirmation statement should be more specifically related to what you are preparing yourself for. For example, a goalie in soccer may say nothing gets by me. Or a shooter in Basketball might say Nothing but net for me. A golfer may repeat a phrase such as I have the perfect swing which will get them in the zone. Keep in mind that you will be asked to perform a physical skill, which will require precision and concentration. Ensure that your affirmation statement is specific and meaningful to you. “you have a steady hand” or “you take direction well” or “you can remain calm under pressure”. Ensure that your affirmation statements are directing you in what to do, not what not to do (for example “you are able to concentrate under pressure” instead of “don’t fumble under pressure”).
Remember to keep your phrases short and specific and positive in nature. Say your phrases with meaning and attention, speaking kindly to yourself. Repeat phrases often to make them automatic. [AUDIO END]

1) Keep in mind that you will be asked to perform a physical skill, which will require **precision** and **concentration.**

2) Ensure that your affirmation statement is specific and meaningful to you. “you have a steady hand” or “you take direction well” or “you can remain calm under pressure”. Ensure that your affirmation statements are directing you in what to do, not what not to do (for

example “you are able to concentrate under pressure” instead of “don’t fumble under pressure”).

3) Remember to keep your phrases **short** and **specific** and **positive** in nature.

4) Say your phrases with meaning and attention, speaking kindly to yourself. Repeat phrases often to make them automatic

*The answers you provide here are for your use only, and will not be accessed by the researchers)

Thank you for your work today.

DAY 10

Review- what have I learned?

[AUDIO] Today we will review a couple of key points. We know that what we think or say to ourselves is critical to our performance as well as our general wellbeing. If our mind was always friendly, there would be no need to monitor, stop, and restructure our thinking. However, as we know that is not always the case, let’s take a moment to list all the types of negative self-talk that hurt your performance or that simply produce other undesirable behaviours. Remember the goal here is recognise what type of situations produce negative thoughts, and question why. [AUDIO END]

Bring back your thought stopping cue word, and stop each thought before it is complete. Now take a moment to practise some of your affirmation statements which will come in handy during your short competition, allowing you to stay calm and focused.
Thank you for your work today.

Testing Day

[AUDIO] Over the last 10 days, you were instructed in the skill of self-talk, which is a technique for gaining control over your mind. Now it is time to put that work into practise. Over the next minute, take time to consider if there are any negative thoughts going through

your mind currently. Then, using your cue word, stop each thought and replace it with one of your affirmation statements. [AUDIO END]

1 min pause

[AUDIO] Take a moment to consider the task you have been asked to do and think about what makes a good throw. It is important to aim directly at your target. Think back over the instructions you were given about how to hold and throw the dart.

Over the next minute, create a few short statements which you think might be useful in helping you stay focused and relaxed during your throws. For example, try coupling you have a steady hand with specific instructions such as keep dart tip up. However, make sure it is a statement that works for you. [AUDIO END]

1 min pause

[AUDIO] Although your talk is more instructional now, ensure that a positive nature is still maintained.

Take another moment to monitor the thoughts that are going on in your head currently, and if there are any negative thoughts present, use your cue word to stop them. [AUDIO END]

30 sec pause

[AUDIO] Repeat your affirmation statements which you have practised, and see if you can implement any more instructional statements regarding your throw. Remember it is important to keep a relaxed but firm grip on your dart. [AUDIO END]

Appendix G – Dart throwing instructions

As you can see, we are not using a traditional board, however, the board has been rigged at competition height, and you will be asked to stand behind the tape, which is competition distance from the dart board.

Basics of the Grip- Keep in mind that darts is not a game of force but rather *touch*.

The chief objective of your grip should be to keep the end of the dart pointing up in each throwing stage. Your grip should be solid and relaxed. You want to use at least three fingers, but not a fist.

You want to Minimize movement, so that Only the shooting arm moves. Your shoulder should stay completely still, as should the rest of your body.

You want to think about having a consistent release, so that you are not releasing to soon (throwing above the board), or too late (throwing below the board).

Snapping of the wrist has shown to help with acceleration in the last phase of your throw. This is an important element, as we are only counting what is left on the board at the end of the game. Therefore, if you just lightly tap a dart on the board, you may knock it off with the following throw if the dart has not been thrown with enough speed.

Finally, a follow-through is critical. You want to follow through with the entire movement even after you have released the dart.

So far, the best throwers have been able to get 75% of their darts within the 6-ring radius.

Appendix H – Systematic literature review

Study	*N*	Sex	Age	PST	Design	Findings	Control	Cognitive Load
(Hardy, Begley, & Blanchfield, 2014)	41	Male	*M* = 20.96, *SD* = 5.3	Self-talk	Randomized counter balanced design.	Skill level important for dominant foot. No support for Instructional ST for non-dominant foot.	n/a	n/a
(Kolovelonis, Goudas, & Dermitzaki, 2012)	85	Mixed	*M* = 11.01 *SD* = 0.67	Self-talk and Goal setting	Proportional stratified sampling method.	ST was effective in enhancing dart throwing.	n/a	n/a
(Zourbanos, Hatzigeorgiadis, Bardas, & Theodorakis, 2013)	40	Mixed	*M* = 11.28 *SD* = 0.82	Self-talk (motivational vs. Instructional)	Randomized with control group	Both Instructional and motivational ST improved performance significantly than control group.	yes	n/a
(Hatzigeorgiadis, 2006)	26	Female	*M* = 19.84 *SD* = 0.78	Self-talk (motivational & Instructional)	Repeated measures. Participants engaged in both instructional & motivational.	According to participants' perceptions, both types of ST helped them mainly to improve their attention to the task.	n/a	n/a
(Beneka et al., 2013)	60	Mixed	*M* = 35.2 *SD* = 3.1	Self-talk (motivational & Instructional)	Between groups (instructional, motivational, no self-talk or neutral).	Balance board time score increased significantly only for experimental groups after the intervention period, and not for control groups. (did not differentiate between the two uses of ST)	yes	n/a
(Harvey, Van Raalte, & Brewer, 2002)	80	Mixed	*M* = 24.90 *SD* = 8.11	Self-talk (Instructional, negative or no self-talk)	Randomized with control group	Instructional ST improved performance. Both negative and positive ST decreased accuracy.	yes	n/a
(Weinberg, Miller, & Horn, 2012)	81	Mixed	*M* = 19.54 *SD* = 1.32	Self-talk: motivational vs. Instructional; assigned vs. chosen statements	Randomized	Results revealed sig improvement in performance of combined ST by 10 sec, motivational ST by 7 sec, and instructional by 8 sec.	n/a	n/a

(Theodorakis, Weinberg, Natsis, Douma, & Kazakas, 2000)	Exp1= 72, Exp2= 48, Exp3= 54, Exp4 = 63	Mixed	**Exp 1:** *M* = 13.56 *SD* = 1.17, **Exp 2:** *M*= 20.6, *SD* = 1.78, **Exp 3:** *M* = 16.9, *SD* = 1.3, **Exp 4:** *M*= 20.98, *SD* = 2.82	Self-talk (motivational vs. Instructional)	4 lab experiments on 4 different motor tasks including Soccer accuracy, badminton service test, sit up test and knee extension task.	**Soccer-** Instructional ST led to best performance. **Badminton-** Instructional ST best performance **Sit-up-** motivational ST best result, but not too diff from control **Knee extension-** motivational better results, not too diff then instructional.	yes	n/a
(Perkos, Theodorakis, & Chroni, 2002)	62	Male	*M* = 12.2	Instructional Self-Talk	Randomized	Experimental groups performed better than control groups when dribbling and passing. ST was most implemented when dribbling & passing but not for shooting – no sig results for shooting.	yes	n/a
(Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004)	120	Mixed	**Exp 1:** *M* = 20.7, *SD* = 1.46 **Exp 2:** *M*= 20.5, *SD* = 1.33 **Exp 3:** *M* = 16.9, *SD* = 1.3	Instructional Vs. Motivational ST	Randomized	Occurrence of interfering thoughts decreased for both types of ST. Precision- both types of ST increased performance. Power task- only motivational ST improved performance.	yes	n/a
Masciana, Van Raalte, Brewer, Branton, & Coughlin, 2001)	30	Mixed	*M* = 25.27, *SD* = 4.73	Zen-based, positive ST, imagery, instruction-drilling, and participant's own (control)	Repeated measures. Participants engaged in a session doing each	Positive ST was the most preferred and the most successful.	yes	n/a

Appendix I – Dart throw scoring

PRACTICE

COMPETITION

Appendix J – Self-talk manipulation check

ID	Qualitative Information	Useful	Easy to implement
5	You always hit your target with a smooth steady hand	4	4
2	Focus and relax	4	4
8	Be steady, you're doing fine	4	4
9	You can do this, just focus.	4	4
11	Did not implement	1	1
15	you can do this, and, focus.	4	5
21	"breathe" "relax" (over and over again), "re-aim" "higher" "lower" "only move your arm"	3	5
23	Stop. Focus. You can do this. YES when dart hit board.	4	4
26	"stop" "think" "breathe" "focus on board"	4	4
27	Clear your thought and focus on the target. This is easy for you.	4	4
31	Keeping the dart tip up helps to get an even grouping. Drown out the noise, it doesn't make a difference.	4	5
41	The positive affirmations regards to technique	4	5
35	Focus, Don't be put off by the noise. Keep your shoulder in the right position. Remember to follow through. Focus! Wow you got one in good stop.	5	4
39	"You have a steady hand" or "you've got this" *note, ticking was distracting.	4	4
43	Be true, focus.	4	4
48	Breathe, steady arm, use previous throws and adjust	4	2
49	You are skilful with a steady hand and Focus	5	4

4 = Agree, 5 = Strongly Agree